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Past plant migrations
in South Africa ✓

The flowering plants which dominate the world to-day are late-comers on the world's surface. South Africa had its share of pre-Angiospermous floras but little is known of their migrations. The Glossopteris flora which flourished in late Palaeozoic times was widely spread in the Southern Hemisphere but little is known of its fate and whether or not it left descendants to become incorporated in later floras. The Gymnospermous floras of Jurassic and early Cretaceous times probably have left their mark on the present floras but our knowledge is so incomplete that no attempt is made to deal with them here.

The flowering plants or Angiosperms appeared with great suddenness towards the end of the Cretaceous period, having no obvious links with the groups of plants which preceded them. No one knows their origin though many theories have been propounded. As yet no claims have been made for Africa as their homeland which is not surprising as Cretaceous fossils are not well represented here. Furthermore groups of plants which botanists usually assume on morphological grounds to be primitive, such as Magnoliaceae, are conspicuously absent from Africa. This being so, the assumption may be made that flowering plants migrated into Africa displacing the early Cretaceous flora in which they had no part. The obvious question then is: what was their source?

At the present time Africa forms an extension of the northern lands in the Old World. Though the Sahara to-day forms a most effective barrier to migration of plants and animals, this was not always so. In earlier times Africa probably received at any rate part of its population from the north. It has even been suggested that South Africa resembles a vast cul-de-sac into which species from the north poured and, having no outlet, became massed in the extreme south. At one time the unusually large number of species in the Cape Flora was explained in this way. It is doubtful if anyone upholds this view at the present time for it is based on the assumption that the continents have maintained their present outlines and relative position throughout the ages, an assumption that few would be prepared to defend.

Little is known about the climate in Tertiary times. The scanty evidence available suggests that for part of the time the climate was more favourable to plant life than at the present time. Deposits at Knysna and East London indicate that trees were common. Even at Banke in Namaqualand fossils of presumed Tertiary age, recovered from a filled in pipe, indicate that the flora at that time contained trees and ferns of a type which could not exist there at the present time. As so little is known about South African plants of the Tertiary Era, evidence of the conditions in other southern lands becomes important. Recent research

has made it clear that during this period there was a widespread southern flora the remains of which have been and are being revealed in rocks of lands in the south, including Antarctica. In South Africa a few Tertiary plant fossils are known, belonging to genera such as *Podocarpus* (yellowwood) and *Curtisia* (Assegaibos) and many more will doubtless be revealed when modern methods of analysis are applied. Evidence for the occurrence in South Africa of a southern element is based, for lack of anything more positive, on a knowledge of present day distribution. Yellowwoods, Assegaibos, Rooi Els and Wild Almond are likely remnants of an old southern flora. Whether this flora advancing from the south met another angiospermous one of northern origin is not known. All that can be stated is that within the forests and streamsides of South Africa elements of both northern and southern origin appear to have mingled. Forests at the present time are best developed in the Knysna-Humandsorp area but isolated patches of the same type of forest occur in sheltered ravines whenever sufficient moisture is assured. The forest and bush of the coastal strip, in the east show an affinity with the forests just mentioned and they too are likely to contain elements derived from the old austral forests. It may be significant that *Peripatus*, that curious archaic creature in the animal kingdom, is confined to the southern land masses and that it occurs in indigenous, moist forest of the type just assumed to contain remnants of the oldest African angiospermous flora.

A feature which characterises an old flora is that no species appears to be much more numerous than any other. The result is a mixed community. This is the case in the forest flora. It also characterises another assemblage of plants, usually termed the Cape Flora. This is not a forest flora for trees in it are rare. The characteristic life form is that of low bush, the plants having either small flat, leathery leaves or even smaller heath-like leaves. It is a flora rich in species and with many unusual plants. It has attracted the attention of botanists since the discovery of the Cape. This flora with its unexplained links with that of Western Australia, has fired the imagination of many who assumed it to be the remains of an old austral flora. However, evidence for such an origin is lacking. Detailed taxonomic and distributional studies of some of the larger genera have given indications of a possible northern origin. Though its headquarters at the present time lie in the south western coastal belt of the Cape Province, especially those parts with a Mediterranean climate, it has left outliers on high ground throughout Africa as far north as Abyssinia. It is difficult to explain disjunctive distribution of this kind in any way but by postulating a once widespread flora which changes of climate have eradicated from most of the lowlands, leaving evidence of its past history on high ground where the climate permits its continued existence. Some indication of its age lies in the fact that certain elements of the montane flora of Madagascar clearly belong to the Cape Flora and have their nearest relatives on the mountains of East Africa. It is usually assumed that Madagascar became detached from the mainland during the latter part of the Tertiary Era and it is therefore obvious that the Cape Flora must have been in existence before the separation took place. Another significant feature is that tropical African species are usually primitive ones in their respective genera. The most highly advanced species are mostly found in the south-west where there is a striking concentration of species. This concentration of species appears to be a secondary feature and may well be connected with the advent of a mediterranean climate in comparatively recent times. The Cape Flora is probably next in age to the forest flora. It is far more tolerant of moderate drought than the latter and was fitted to survive at times when a dry period challenged the existence of forest in all but the most sheltered places. Little is known of the Tertiary and Quaternary history of South Africa but what is known suggests that there were fluctuations of climate, very dry and somewhat humid periods alternating.

Another notable type of vegetation is what may be termed the Namib-Karoo. It is chiefly developed in the west, extending from South West Africa, through Namaqualand to the coastal ranges which form the boundary of the Cape Flora. It extends eastwards to

about the longitude of Port Elizabeth. In outline its territory is like a somewhat distorted axe standing on its head. In the west the junction with the Cape Flora is usually sharp but in the east the boundaries are much less definite. In places the Karoo approaches true desert but over most of its area it is best described as semi-desert. Succulents form an important element, especially in the west and give this type of vegetation a character unique in the Southern Hemisphere. The Karoo Flora is adapted to a low and erratic rainfall. With increasing altitude and the likelihood of severe frost during the winter, succulents disappear and are replaced by sparse, low bush with grasses occupying the ground between bushes after a rainy period. The past history of this most interesting arid type of vegetation is obscure. There are no indications that it arose anywhere but in South Africa and there are no clues as to its age. It is adapted to life under arid conditions and probably arose in one or more of the dry periods in South Africa's history. It is presumably younger than the Cape Flora for the striking discontinuities in distribution which are a feature of the latter, do not appear in it. Far too little is known about it to hazard a guess as to its age though it is almost certainly older than the floras lying to the north.

Its relations with the Cape Flora in the west are interesting. In a place such as Ladismith at the foot of the Swartberg, the Karoo flora appears adjacent to a major outlier of the Cape Flora. The slopes of the Swartberg are covered with typical Cape vegetation. Just to the south a number of koppies, running from east to west, have a rainfall of approximately 10 in. a year, an amount which is critical for these two floras. Even a change of aspect is enough to determine which of these two floras is to be in possession of the ground. The drier northern slopes are covered with succulent Karoo bushes while the shaded southern slopes have a flora of the Cape type. The sharpness of the boundaries in such places suggests that both floras are old and have reached an equilibrium, each holding its own when its specific water requirements are met.

Both the Cape and succulent Karoo floras agree in being unable to withstand severe frosts. The essential difference between the two lies in their water requirements. Thus in arid periods the Karoo flora would tend to invade the domain of the Cape and in the more humid periods the position would be reversed. Historical migrations of this kind would explain the presence of such typical Karoo plants as *Cotyledon paniculata* (Botterboom), *Crassula rupestris* and *Euphorbia mauritanica* (Geel Melkbos) in present day Cape territory. For instance these plants have a somewhat precarious foothold on the Cape Peninsula where conditions for their existence are not favourable. They are Karoo elements in an area that is now almost entirely populated by members of the Cape Flora. The case of the Worcester—Robertson Karoo is somewhat different. There an island of unmistakable Karoo vegetation is surrounded on all sides by the Cape flora. Here too the explanation may well be that in this restricted area of low rainfall, lying to the south of the Langeberg, remnants of a past invasion may have survived but the mystery remains as to why this flora is confined to rocks of Karoo age.

To the north and east of the three floras just discussed, South Africa is covered by a much younger flora having clear affinities with the vast flora of tropical Africa. It is by no means a uniform flora for at high altitudes where severe frosts are common, it assumes the form of grassland. At lower altitudes and with less likelihood of frost, trees appear and grassland gives way to savanna. A sign of youthfulness, such as a tendency for one species to assume dominance at the expense of the others, is there. It is generally accepted that this is the youngest and it is certainly the most widely spread of the South African floras. The annual rainfall varies within wide limits but it is less erratic than that of the Karoo and occurs during the summer months.

Rainfall and temperature, particularly low temperature, are important factors in determining the type of vegetation in a given area, but at the same time the historical back-

ground cannot be dismissed as unimportant. There have obviously been migrations of considerable magnitude but until South African palaeobotany receives more attention that it has in the past and until more is known of past climates, the subject remains to a large extent in the realm of conjecture.

DISCUSSION

Mr. Skead: What is the relationship between *Daedoxylon* and *Podocarpus*?

Dr. Levyns: None.

Dr. Plumstead: *Daedoxylon* is an Araucarian wood, not represented in the present South African flora.

Dr. Poynton: Can you date the *Podocarpus* forest type? Is it of the same date as *Nothofagus* forest?

Dr. Levyns: Yes.

Dr. Schelpe: The distribution of ferns supports Dr. Levyns' conclusion. The great bugbear in distribution problems is that, once the pattern of distribution has shown migration, it is difficult to decide in which direction the migration has taken place. The cytology of certain ferns, which have a higher chromosome number in the Cape than further north, indicates a northern origin of the flora.

Prof. van Zinderen Bakker: Do the leaves found in the northern hemisphere really belong to the Proteaceae? The evidence seems to be doubtful.

Dr. Levyns: The evidence is, indeed, doubtful.